

# **To Glove or Not to Glove? Investigations into the potential contamination from handling of paper-based cultural heritage through forensic fingerprinting approaches**

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## **Supplementary information: Fingermark development techniques**

### ***1,2-indanedione***

The indandione-zinc solution was prepared following the Australian Federal Police guidelines <sup>1</sup>(37). However, petroleum spirits were used instead of HFE-7100 as it was more cost-effective.

### ***Materials***

1,2-indanedione (CASALI/Optimum Technology, Australia), anhydrous zinc chloride (BDH, USA), ethyl acetate, petroleum spirits (Univar Analytical, Australia), glacial acetic acid, and absolute ethanol (CSR chemicals, Australia). Reagents were of analytical grade and used as received. Fingermarks were developed on Staples's brand white copy paper.

### ***Preparation and development of fingermarks in 1,2-indandione solution***

The 1,2-indanedione stock solution was prepared with 1,2-indanedione (4 g) dissolved in ethyl acetate (450 mL) and glacial acetic acid (50 mL). The zinc chloride stock solution contained zinc chloride (8 g) dissolved in ethanol (200 mL). The final working solution was made up with zinc chloride stock solution (2 mL) and 1,2-indanedione stock solution (50 mL) added to petroleum spirits (450 mL).

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<sup>1</sup> Stoilovic M, Lennard C. AFP Workshop Manual: Fingerprint Detection and Enhancement. 3rd ed. Canberra: Forensic Services, Australian Federal Police; 2006.

Samples were developed by immersing the paper substrate in the working solution and then air-dried before placing the paper between the plates of an Elna laundry press for heat treatment at 160°C for 10 seconds. Samples were viewed and photographed using a Rofin Polilight PL500 using a wavelength of 505 nm with an orange (550 nm) barrier filter and a Nikon D300 camera.

### ***Single Metal Deposition II***

The solutions for SMDII were prepared according to Moret and Bécue <sup>2</sup>(46) and Newland *et al.* <sup>3</sup>(35).

### ***Materials***

Tetrachloroauric acid trihydrate, trisodium citrate dihydrate, sodium hydroxide, l-aspartic acid, Tween 20, citric acid monohydrate, and hydroxylamine hydrochloride (Sigma–Aldrich, USA). Reagents were of analytical grade and used as received. Fingermarks were developed on NU:World stone paper.

### ***Preparation of SMDII stock solutions***

Five stock solutions were made. Solution A and the colloidal gold-stock solution was stored at 4 °C while. The other four solutions were stored at room temperature in the dark.

- Solution A: tetrachloroauric acid trihydrate (0.500 g) dissolved in Milli-Q water (5 mL)
- Solution B: trisodium citrate (1.70 g) dihydrate dissolved in Milli-Q water (85 mL)

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<sup>2</sup> Moret S, Bécue A. Single-Metal Deposition for Fingermark Detection-A Simpler and More Efficient Protocol. *Journal of Forensic Identification*. 2014;65(2):118-37.

<sup>3</sup> Newland TG, Moret S, Bécue A, Lewis SW. Further investigations into the single metal deposition (SMD II) technique for the detection of latent fingermarks. *Forensic science international*. 2016;268:62-72.

- Solution C: sodium hydroxide (0.120 g) and L-aspartic acid (0.380 g) dissolved in Milli-Q water (25 mL)
- Solution D: citric acid monohydrate (31.5 g) dissolved in Milli-Q water (150 mL)
- Solution E: hydroxylamine hydrochloride (1.00 g) dissolved in Milli-Q water (50 mL)

The colloidal gold-stock solution was prepared by adding Solution A (1 mL) to deionized water (450 mL) and heating with constant stirring until boiling. A second mixture of Solution B (42 mL) and Solution C (420  $\mu$ L) was added at this point. The mixture was boiled till a deep red color was observed and then diluted with deionized water to a volume of 2.5 L. Tween 20 (2.5 mL) was added to this cooling solution with further stirring. The colloidal gold stock was stored in a polypropylene container at 4 °C.

#### *Development of fingerprints with SMDII*

Fingerprint samples were initially soaked in a deionized water bath for 2-3 minutes before being added to a gold nanoparticle bath made of room temperature colloidal gold-stock solution (200 mL) and Solution D (6 mL). This bath was kept in constant motion using a PathTech Basic Orbital Mixer at approximately 50 RPM for 20 minutes. Samples were rinsed again in a deionized water bath for 2-3 minutes and added to a gold salt reduction bath made from Solution A (200  $\mu$ L), Solution E (200  $\mu$ L), and Milli-Q water (200 mL). This mixture was also moved continuously for another 20 minutes. Samples were rinsed in a final bath of deionized water for 2-3 minutes before being left to dry at room temperature on a paper towel.

Table 1: Gloves worn by donors for handling testing

<b>Glove Name</b>	<b>Brand</b>	<b>Product Code</b>	<b>Standard of Manufacture</b>	<b>Lot/ Batch No</b>	<b>Country of manufacture</b>	<b>Glove Type</b>	<b>Expiry Date on Box</b>
TouchNTuff	Ansell	92-600	AQL 4.0	1503087228	Thailand	Nitrile	Yes
Premium Nitrile Examination Gloves	Hospitality Essentials	3439407	ISO 9001		Malaysia	Nitrile	No
Silk Fit	Mirella Research	SFN-M	-	1009050159	Malaysia	Nitrile	Yes
Sa'fresh	WSP	DNBkM	ISO 9001	DS1505E	China	Nitrile	No
Vinyl Examination Gloves	ProMed	PMD1301	ASTM D5250(01)	150740156100	Malaysia	Vinyl	Yes
Nitrile Examination Gloves	ProMed	PMD172080	ASTM D6319(01)	2709005312004	Malaysia	Nitrile	Yes
Micro-Touch NitreTex E.P.	Ansell	4691	-	13080143EP	Malaysia	Nitrile	Yes
Multi Sensitive Disposable Glove	Ansell	-	-	-	Malaysia	Nitrile	No
Cotton Gloves	SurgiPack	6099	NA	-	China	Cotton	NA